

## CLAIMS

- 1 1. A method of p-type doping in ZnO comprising:  
2 forming an acceptor-doped material having ZnO under reducing conditions,  
3 thereby insuring a high donor density; and  
4 annealing the specimens of said acceptor-doped material at intermediate  
5 temperatures under oxidizing conditions so as to remove intrinsic donors and activate  
6 impurity acceptors.
- 1 2. The method of claim 1, wherein said reducing conditions comprise a hydrogen  
2 containing atmosphere.
- 1 3. The method of claim 1, wherein said reducing conditions comprise a non- hydrogen  
2 containing atmosphere.
- 1 4. The method of claim 1, wherein said acceptor-doped material comprises a substrate, a  
2 n-type ZnO layer deposited on said substrate, and a p-type layer deposited on said n-type  
3 ZnO layer.
- 1 5. The method of claim 1, wherein said intermediate temperatures comprise a  
2 temperature range between 200 °C and 700 °C.
- 1 6. A method of forming p-n junctions using p-type ZnO comprising:  
2 forming an acceptor-doped material having ZnO under reducing conditions,  
3 thereby insuring a high donor density; and

4        annealing the specimens of said acceptor-doped material at intermediate  
5        temperatures under oxidizing conditions so as to remove intrinsic donors and activate  
6        impurity acceptors.

1        7. The method of claim 6, wherein said reducing conditions comprise a hydrogen  
2        containing atmosphere.

1        8. The method of claim 6, wherein said reducing conditions comprise a non- hydrogen  
2        containing atmosphere.

1        9. The method of claim 6, wherein said acceptor-doped material comprises a substrate, a  
2        n-type ZnO layer deposited on said substrate, and a p-type layer deposited on said n-type  
3        ZnO layer.

1        10. The method of claim 6, wherein said intermediate temperatures comprises a  
2        temperature range between 200 °C and 700 °C.

1        11. A wide band gap semiconductor device comprising an acceptor-doped material  
2        having ZnO that is formed under reducing conditions, thereby insuring a high donor  
3        density; wherein the specimens of said acceptor-doped material are annealed at  
4        intermediate temperatures under oxidizing conditions so as to remove intrinsic donors  
5        and activate impurity acceptors.

1        12. The wide band gap semiconductor device of claim 11, wherein said reducing  
2        conditions comprise a hydrogen containing atmosphere.

1 13. The wide band gap semiconductor device of claim 11, wherein said reducing  
2 conditions comprise a non- hydrogen containing atmosphere.

1 14. The wide band gap semiconductor device of claim 11, wherein said acceptor-doped  
2 material comprises a substrate, a n-type ZnO layer deposited on said substrate, and a p-  
3 type layer deposited on said n-type ZnO layer.

1 15. The wide band gap semiconductor device of claim 11, wherein said intermediate  
2 temperatures comprise a temperature range between 200 °C and 700 °C.

1 16. A p-n junction comprising an acceptor-doped material having ZnO that is formed  
2 under reducing conditions, thereby insuring a high donor density; wherein the specimens  
3 of said acceptor-doped material are annealed at intermediate temperatures under  
4 oxidizing conditions so as to remove intrinsic donors and activate impurity acceptors.

1 17. The p-n junction of claim 16, wherein said reducing conditions comprise a hydrogen  
2 containing atmosphere.

1 18. The p-n junction of claim 16, wherein said reducing conditions comprise a non-  
2 hydrogen containing atmosphere.

1 19. The p-n junction of claim 16, wherein said acceptor-doped material comprises a  
2 substrate, a n-type ZnO layer deposited on said substrate, and a p-type layer deposited on  
3 said n-type ZnO layer.

1 20. The p-n junction of claim 16, wherein said intermediate temperatures comprises a  
2 temperature range between 200 °C and 700 °C.